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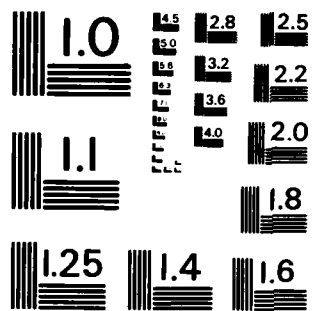
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**TAILORING SHIPBOARD TRAINING TO FLEET
PERFORMANCE NEEDS: VI. DEVELOPMENT
OF SHIPBOARD PROPULSION PLANT
OPERATOR TRAINING (SPPOT) MATERIALS
FOR USS NEW JERSEY**

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VI. DEVELOPMENT OF SHIPBOARD PROPULSION PLANT OPERATOR
TRAINING (SPPOT) MATERIALS FOR USS NEW JERSEY**

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM						
1. REPORT NUMBER NPRDC SR 83-44	2. GOVT ACCESSION NO. AD-A131090	3. RECIPIENT'S CATALOG NUMBER						
4. TITLE (and Subtitle) TAILORING SHIPBOARD TRAINING TO FLEET PERFORMANCE NEEDS: VI. DEVELOPMENT OF SHIPBOARD PROPULSION PLANT OPERATOR TRAINING (SPPOT) MATERIALS FOR USS NEW JERSEY		5. TYPE OF REPORT & PERIOD COVERED Final Report 1981-1982						
7. AUTHOR(s) Kirk Johnson Iver J. Rivenes, Jr. James G. Chadbourne		6. PERFORMING ORG. REPORT NUMBER 14-82-16						
9. PERFORMING ORGANIZATION NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152		8. CONTRACT OR GRANT NUMBER(s)						
11. CONTROLLING OFFICE NAME AND ADDRESS Navy Personnel Research and Development Center San Diego, California 92152		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS N0002482 WR30614						
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE June 1983						
		13. NUMBER OF PAGES 18						
		15. SECURITY CLASS. (of this report) UNCLASSIFIED						
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE						
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.								
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)								
18. SUPPLEMENTARY NOTES								
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table border="0"> <tr> <td>Training</td> <td>Engineering training</td> </tr> <tr> <td>Shipboard training</td> <td>Personnel qualification standards (PQS)</td> </tr> <tr> <td>On-site training</td> <td>Shipboard propulsion plant operator training (SPPOT)</td> </tr> </table>			Training	Engineering training	Shipboard training	Personnel qualification standards (PQS)	On-site training	Shipboard propulsion plant operator training (SPPOT)
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Shipboard training	Personnel qualification standards (PQS)							
On-site training	Shipboard propulsion plant operator training (SPPOT)							
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <p>Shipboard propulsion plant operator training (SPPOT) materials were developed for USS NEW JERSEY (BB 62) and were delivered prior to commissioning so as to help the crew prepare for light-off. SPPOT materials provide the information needed to qualify for specific watchstations in the main propulsion spaces on specific ships. This report describes the materials, their development, and the resources that were required.</p>								

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FOREWORD

The purpose of this project, which was conducted under a work request from Commander Naval Sea Systems Command (PMS 378), was to develop shipboard propulsion plant operator training (SPPOT) materials for USS NEW JERSEY (BB 62). SPPOT materials are designed for shipboard use in training engineering personnel for specific watchstations on specific ships. This report, which describes the development of SPPOT materials for NEW JERSEY and documents the resources that were required, is intended for those interested in shipboard training generally and in the development of SPPOT materials in particular.

This is the sixth report published by this Center on tailoring shipboard training to fleet performance needs. The others, which were prepared under subproject Z1180-PN.01 (Enhancing Fleet Training Readiness Through Improved Shipboard Training), provide a general introduction to the overall project (NPRDC TRs 78-30 and 81-23), descriptions of the SPPOT program, as well as SPPOT modules and guides (NPRDC TRs 82-6 and 82-61), and a handbook for the development of SPPOT materials (NPRDC TR 83-9).

Special thanks are due to CDR P. Martineau, Engineering Officer, LCDR J. Jones, Main Propulsion Assistant, and other Engineering Department personnel of NEW JERSEY for their assistance with many aspects of the project, particularly with the technical content of the materials; to Mr. D. Hatfield of EG&G Corporation; and to Mr. D. Blanchard and Mr. C. Austin of the Long Beach Naval Shipyard, for their assistance in obtaining technical documentation.

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SUMMARY

Problem and Background

The reactivation of the Navy's four IOWA-class battleships began in early 1981 with USS NEW JERSEY (BB 62). The reactivation schedule for NEW JERSEY was highly compressed, with the actual yard period extending from September 81 to December 82.

One of the fleet's most frequently cited shipboard training problems is the preparation of qualified engineering watchstanders. This problem was particularly serious for NEW JERSEY since all engineering training was done by the ship without a precommissioning training detachment or the assistance of a Fleet Introduction Team.

Since 1977, the Navy Personnel Research and Development Center has been working on a project to improve shipboard training. A major product of this work is the shipboard propulsion plant operator training (SPPOT) program, which provides on-the-job training materials to assist engineering personnel to qualify for specific watches on specific ships. SPPOT materials have been developed for two aircraft carriers and several frigates.

Objective

The objective of this effort was to develop similar SPPOT materials for NEW JERSEY. The materials were to be ready in time to help NEW JERSEY Engineering Department personnel prepare for plant light-off.

Approach

SPPOT materials consist of (1) training modules that provide information of the kind required in the fundamentals and systems sections of the Personnel Qualification Standards (PQS), (2) guides, or training-oriented job-performance aids, that lead the student through tasks of the kind specified in the PQS watchstation section, and (3) administrative aids that help both the students and instructors to establish a systematic training program that is coordinated with PQS requirements.

There are enough basic similarities among conventional steam propulsion plants so that most SPPOT materials for a new ship can be developed by using the new ship's technical documentation to tailor existing SPPOT materials, developed for other ships, to the new ship. This can generally be accomplished by relatively naive personnel with occasional help from subject matter experts (SMEs). However, since there were gaps in NEW JERSEY's technical documentation, it was necessary to rely much more heavily on SMEs and to make frequent visits to the ship.

Results

SPPOT materials were prepared for the 13 watchstations in the main propulsion spaces (separate materials were not prepared for watch supervisors). The development of modules and guides required about 2 man-years of effort by writers and slightly over 2 man-years of effort by SMEs and editors. Camera-ready copies were prepared under a separate contract. The work was completed in 8 months.

Conclusions

The SPPOT materials were delivered on schedule, and the ship's personnel thought they made a significant contribution to engineering training. The development of SPPOT materials for NEW JERSEY was complicated by a number of factors, including lack of a validated engineering operational sequencing system, gaps in the ship's technical documentation, uncertainties about the ship's ultimate configuration, and the absence of personnel with experience on the ship. Because of these difficulties, the effort expended on this project was greater than that which would have been required to develop SPPOT materials for an already operational ship.

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INTRODUCTION

Problem and Background

The reactivation of the Navy's four IOWA-class battleships began in early 1981 with USS NEW JERSEY (BB 62). The reactivation schedule for NEW JERSEY was highly compressed, with the actual yard period extending from September 1981 to December 1982.

The preparation of qualified engineering watchstanders is one of the fleet's most frequently cited shipboard training problems. This problem was particularly serious for NEW JERSEY since all engineering training was done by the ship without a precommissioning training detachment or the assistance of a Fleet Introduction Team. None of the engineering personnel had previous experience on this type of ship, and many documents that would have facilitated training (most notably, a validated engineering operational sequencing system (EOSS)), were not available for training purposes prior to light-off.

Since 1977, the Navy Personnel Research and Development Center (NAVPERSRAND-CEN) has been working on a project to improve shipboard training (Main, Abrams, Chiles, Flaningam, & Vorce, 1978; Chiles, Abrams, Flaningam, & Vorce, 1981). A major product of this work is the shipboard propulsion plant operator training (SPPOT) program, which provides on-the-job training materials to assist engineering personnel to qualify for specific watches on specific ships (Main, Abrams, Chiles, Todd, & Cunanan, 1981; Main, Abrams, Chiles, & Todd, 1982; Main, Steinemann, Rivenes, & Chadbourne, 1983). The SPPOT materials have been developed for two aircraft carriers and several frigates.

Objective

The objective of this effort was to develop similar SPPOT materials for NEW JERSEY, as requested by the Naval Sea Systems Command (PMS 378). The materials were to be ready in time to help personnel of the NEW JERSEY Engineering Department prepare for plant light-off. This report describes the development of the materials and the resources that were required.

APPROACH

The general approach to developing SPPOT materials for NEW JERSEY was similar to that followed previously in developing materials for other ships. The kinds of materials were the same, and the procedures used in writing and reproducing them were based on experience gained with the previous ships.

SPPOT Materials

SPPOT materials are designed to be (1) used in a shipboard environment, (2) consistent with and complementary to Personnel Qualification Standards (PQS) and EOSS, and (3) hull-specific. They cover all watchstations in main propulsion spaces except those for watch supervisors and include the following elements:

1. Modules. These are instructional booklets designed to provide a convenient centralized source of information needed to meet PQS fundamentals and systems requirements. Like PQS, they are designed to cover "minimum" requirements for qualification. They include instructional material (with extensive use of drawings, schematics, and charts), practice exercises, and tests.

2. Guides. These are pocket-sized, laminated, step-by-step procedural guides for normal plant operation. They are based on the EOSS component procedures (CPs), but they are more detailed, and the individual steps are organized into functional blocks. They contain explanations of (a) what is being accomplished within each block and (b) what might happen if certain steps are not performed as specified. These explanations provide the additional information needed to satisfy requirements in the PQS tasks section. The guides are used only for training; watchstanders must use the CPs during actual operations. The guides do not cover the engineering operational casualty control (EOCC) portion of EOSS.

3. Administrative Aids. These include (a) directions, for both students and instructors, on the use of SPPOT materials and (b) a revised PQS that indicates which requirements can be satisfied by which modules and which guides should be used for which tasks.

Development of Materials

There are enough basic similarities among conventional steam propulsion plants so that most of the SPPOT materials needed for a new ship can be developed by using the new ship's technical documentation to tailor existing SPPOT materials, developed for other ships, to the new ship. The typical SPPOT development team consists of subject matter experts (SMEs), writers, and editors. In most cases, the actual writing or revision is done by relatively naive personnel with occasional help from the SMEs. This helps to ensure that none of the explanatory material needed by inexperienced personnel is omitted, as it might be if the writing were done by highly experienced personnel to whom such explanations might seem superfluous. Since much of the technical documentation for NEW JERSEY was either out-of-date or missing, it was necessary to rely more heavily on the SMEs and to make frequent visits to the ship to check its actual configuration.

Most of the SMEs were senior petty officers from engineering ratings (boiler technician, machinist's mate, and electrician's mate). NAVPERSRANDCEN provided from three to five SMEs to the SPPOT program on a full-time basis, but part of their time was devoted to developing materials for other ships. The PQS Development Group and NEW JERSEY both provided SMEs who worked directly on the SPPOT materials during the early phases of the project and then provided liaison with the project following their return to their parent organizations. Most of the writing was done by contractors, about half of whom had had previous experience in developing SPPOT materials for other ships.

As the first step in developing a module for NEW JERSEY, a SME reviewed existing modules from USS CONSTELLATION (CV 64) and USS DOWNES (FF 1070), located those that might be modified to fit NEW JERSEY, and noted the areas that required revision. He also located the technical materials (generally excerpts from Navy or manufacturer technical manuals) needed for the revision. When the necessary information was not available from other sources, it was obtained directly from the ship in the form of notes or sketches. The package of existing modules and technical information was then given to one of the students who actually wrote the new module. In some cases, an existing module could be revised by changing a few words. In most cases, though, sizeable sections had to be revised, and many of the drawings and schematics had to be replaced. In a few cases, there were no existing modules of the proper kind, and new modules had to be developed from scratch.

In many cases, the student had to go back to the SME for help in filling gaps or resolving conflicts in the technical information. The student's draft of the new module was reviewed by an SME for technical accuracy and by two editors for clarity and proper format. When the necessary corrections had been made, it was given to a contractor for a final check on technical accuracy and for conversion from handwritten draft to camera-ready copy. The camera-ready copy was reviewed once again by NAVPERSRANDCEN prior to printing. Some printing and binding was done by NAVPERSRANDCEN; the rest was done by the local Navy Publication and Printing Service Office.

Similar procedures were followed in developing the new guides. Existing guides were reviewed and technical information, including the preliminary CPs, were provided to students who did the actual writing. After they were reviewed, the handwritten drafts were given to a contractor for printing in their final laminated form.

RESULTS AND DISCUSSION

A complete set of SPPOT materials was developed for USS NEW JERSEY. These materials, some of the difficulties encountered in their development, and the estimated resources required are described below.

Materials Developed

Modules

A total of 61 modules were developed and organized into 14 packages: An orientation package, to be used by all watchstanders, and 13 watchstation packages for the individual watchstations listed in Table 1. Packages were not developed for watch supervisors or for watchstations outside the main propulsion spaces. The modules in the orientation package were included only in that package; those in the watchstation packages were included in from one to five packages each, for an average of slightly over two packages. Most of these modules covered a specific system or equipment. Any given module was included in the package for every watchstation that required work with that equipment.

The length of individual modules ranged from 8 to 97 pages, with an average of about 29 pages. The types of pages are summarized in Table 2. Although text pages were rarely repeated, many of the drawings were repeated exactly or with variations limited to the labeling of parts.

The initial printing of modules for NEW JERSEY consisted of 450 copies of the orientation package, 100 copies of the burnerman watchstation package, and 50 copies each of the other 12 watchstation packages. This represents a total of almost 350,000 pages.

Guides

Fifty-eight guides were developed. A single guide generally covered a number of related operations. For example, the guide on the main feed pump included sections on preparing for operation, starting, operational checks, securing, stopping during casualty, and starting after casualty. Individual guides ranged from 4 to 72 pages, with an average of about 13 pages.

Table 1
Orientation and Watchstation Packages

Package	No. ^a Modules	Pages
Orientation	16	432
Watchstation:		
Cold iron watch	2	37
Engineroom messenger	5	84
Thrust block watch	4	95
Throttleman	4	175
Engineroom lower-level watch	13	440
Ship's service turbogenerator watch	5	229
Electrical switchboard operator watch	3	46
Pumpman	10	337
Engineroom upper-level watch	11	358
Fireroom messenger	7	135
Burnerman	6	194
Checkman	4	146
Fireroom lower-level watch	20	582

^aTotal equals 110 rather than 61, since modules in watchstation packages were included in from one to five packages.

Table 2
Types of Pages in Modules

Type of Page	No. of Pages
Text (both narrative materials and tables)	1,116
Drawings (both line drawings and schematics)	
Original	262
Repetitions	375
Total	1,753

A complete set of guides was provided for each of the ship's four propulsion plants. The set was distributed into eight metal containers located within each plant. There was generally a single guide of each kind within a set, but a few that would be used at more

than one watchstation were duplicated for location in more than one container. The initial printing provided one complete backup for the initial distribution, for a total of 7,760 laminated pages, plus three nonlaminated copies of each guide to be used for reference purposes.

Administrative Aids

A preliminary draft of the PQS booklet for main propulsion was available early in the project, but the final draft was scheduled for publication several months after the modules and guides would be delivered to the ship. To minimize revisions and simplify the administrative burden on the ship, it was decided to defer preparation of the PQS/SPPOT concordance until both the PQS and SPPOT materials had been revised.

Implementation of Program

Experience with other ships had indicated that the SPPOT program functions more effectively if it is implemented as a unified whole, rather than incrementally as the materials become available. Because of time pressures and training needs, however, it was decided to deliver materials to NEW JERSEY as they became available. The implementation was further complicated by the conflicting operational demands imposed by the compressed reactivation schedule. In spite of these less than optimal conditions, the materials were well received by the ship. In a letter to Chief of Naval Operations, dated 1 November 1982, NEW JERSEY stated that "overall knowledge, operator skill and confidence have been increasing significantly" by the material and "strongly recommend the implementation of the shipboard propulsion plant operator training (SPPOT) program throughout the fleet."

Resources

The following estimates reflect the major resources required to produce the initial set of materials delivered to the ship. These materials were based on the technical information available at the time of their development. Some of this technical information has already changed and there may be additional changes prior to commissioning. The materials will need revision, but the amount of change needed should be minimum.

1. Labor. Table 3 provides estimates of the number of man-months spent in developing the SPPOT materials and camera-ready copy. The management category covers, in addition to time spent in the direct supervision of production and work on specific contracts, time spent in activities such as briefings, the procurement of reference materials, and general liaison with sponsors and users. Since the latter activities contributed to the development of both modules and guides, management time was arbitrarily split between the two types of development in a manner proportionate to the splits within the writer and SME/editor categories.

2. Travel. NAVPERSRANDCEN personnel spent approximately 50 man-days on trips from NAVPERSRANDCEN (San Diego) to NEW JERSEY (Long Beach Naval Shipyard) to check the actual configuration of equipment on the ship. The contractor (also located in San Diego) made similar trips, though not as many, to verify the modules.

Table 3
Man-months Spent Developing Modules and Guides

Type of Labor	Type of Material	
	Modules	Guides ^a
<u>In-house:</u>		
Management	3.7	1.9
Writer	15.5	7.9
SME/Editor	17.4	8.6
Total in-house labor	36.6	18.4
<u>Contract (Developing camera-ready copy):</u>		
Program Manager	.7	--
Subject Matter Expert	14.0	--
Technical Illustrator	12.0	--
Production Typist	8.0	--
Quality Assurance	1.3	--
Total contract labor	36.0	
Total labor	72.6	18.4

^aNo estimate is provided for the guide production contract since this was essentially a piece-rate effort that does not readily convert to man-months.

3. Time. An initial period of about 2 calendar months was spent in general preparation for the project. This included activities such as liaison with sponsors and the ship, the location and procurement of reference materials, and the arrangement for contract support. This was followed by about 4 calendar months of intensive work on the modules. Normally, modules and guides would be developed concurrently, but it was decided to postpone work on the guides until a draft EOSS became available. The last 2 calendar months were spent in intensive work on the guides. The total project required 8 calendar months.

The orientation packages were delivered about 1 month after the first major increment of personnel arrived at the ship, and the remaining materials were delivered over a period of about 3 months. All materials (except the administrative aids) were in place about 2 months prior to the first scheduled light-off by the ship's crew.

Lessons Learned

The primary reason for describing the development of SPPOT materials for NEW JERSEY is to provide a basis for estimating the effort that might be required to develop materials for additional ships.

The amount of material that must be developed for major combatants with conventional steam plants does not seem to vary appreciably across ships, regardless of size. Roughly the same number of modules and guides of roughly the same sizes were required for CONSTELLATION, DOWNES, and NEW JERSEY. The number of copies of each module and guide required for ships with four propulsion plants was roughly four times the number required for the ship with a single plant.

The effort required to develop materials for a new ship is dependent, in part, on the similarity between the equipment on the new ship and the equipment on some ship for which materials have already been developed. When similarity is very high, as it was for the additional 1052-class frigates done after DOWNES, most of the materials can be produced from existing tapes and diagrams with no modification. Although precise estimates are not available, the cost is probably about one-tenth the cost of developing materials for the first ship in a class. When equipment is less similar, as it would be on a different class of 1200 psi ships, the level of effort would be considerably higher, but there would still be considerable savings. NEW JERSEY probably required more modifications than any effort since the original development, since it was the first 600 psi ship for which materials were developed, much of the equipment was old, and there were fewer automatic controls. Even so, some materials could be used with few modifications, and existing materials provided good models for developing new materials for most systems and equipment. The level of effort would be much higher for the first gas turbine or diesel ship.

Considerable additional effort was required in developing materials for this project because, in many respects, NEW JERSEY is like the lead ship in a new class, and the SPPOT materials had to be delivered prior to the delivery of the ship itself. In all previous cases, materials were developed for an operational ship. For those ships, the technical documentation was reasonably complete and up-to-date, a functional plant was available as the ultimate source of information on equipment and configuration, and experienced, qualified watchstanders were available as consultants. In each case, there was a stable PQS and a validated EOSS. None of these resources were available for NEW JERSEY.

Because of deficiencies in the technical documentation, both SMEs and writers frequently found themselves working with several conflicting sources of partial information rather than a single validated document. This meant that a considerable amount of time was spent in cross-checking information, either between documents or against the ship. Even the ship presented problems, since part of its equipment was missing and changes were still being made in its proposed configuration. It is quite possible that these documentation problems were more severe for NEW JERSEY, an old ship being reactivated for the third time, than they would be for a ship that really was the lead ship in a new class.

The problems of coordinating SPPOT materials with both PQS and EOSS were exacerbated by the concurrent development schedules. The preliminary PQS was published shortly after work began on the modules, and the pre-hot check EOSS was published immediately prior to the start of work on the guides. Both PQS and EOSS were

developed on accelerated schedules and, in both cases, the development was hampered by the absence of good technical documentation and experienced watchstanders. It was anticipated that both documents would require substantial modification before final publication; thus, even though the preliminary drafts were extremely helpful, they did not resolve all ambiguities. The final drafts were not available until several months after the delivery of the SPPOT materials, and both contained significant changes.

In short, the cost of SPPOT materials is greater when the materials are delivered before commissioning instead of after commissioning. Part of this difference is due to the extra effort required to develop the initial materials from incomplete and uncertain information, and part is due to the need for revisions once the ship's configuration and procedures have stabilized. The cost of both components will be greater when the ship is the first in its class. These additional costs must be weighed against the advantages of using SPPOT materials during precommissioning training. It should be noted, however, that the SPPOT guides are highly dependent on the EOSS, and under a normal schedule the shipchecked EOSS would not be available in time to support the development of guides prior to delivery of the ship.

CONCLUSIONS

The SPPOT modules and guides were delivered to NEW JERSEY on schedule and in time to help engineering department personnel prepare for light-off. The materials were well recieved by the ship, even though time pressure and operational commitments precluded their optimal utilization.

The efficiency and cost of developing materials for NEW JERSEY were adversely affected by the need for delivery in time to support training prior to the delivery of the ship. Similar increases in cost should be anticipated in developing SPPOT materials for any new construction and, in particular, for the lead ship in a new class.

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